Classification Discussion: Endosseous Dental Implants (Blade-form - Class III)

Meeting of Dental Products Panel of the Medical Devices Advisory Committee

Gaithersburg, MD

July 18, 2013

Purpose of Panel Meeting

The purpose of this panel meeting is to discuss the available scientific evidence regarding the use of endosseous dental implants (blade-form). The panel will be asked to make recommendations regarding regulatory classification to either reconfirm to class III (subject to PMA) or reclassify to class I or class II (subject to 510(k)).

Presentation Outline

- Introduction
- Device Description and Regulatory History
- Clinical Background
- OSB Systematic Literature Review
- Adverse Event Analysis
- Risks to Health / Special Controls
- Summary

FDA Review Team

Classification Review Team

- Andrew I. Steen, B.S.
- M. Susan Runner, D.D.S.

MAUDE Search Team

- Celia Chau

Epidemiology Literature Review Team

OSB:

- Carolina Alvarez-Garriga, M.D., Dr.P.H
- Samantha Jacobs, B.S.
- Xueying Sharon Liang, M.D. Ph.D.
- Cindy Kwan, B.S.
- Shaokui Wei, M.D. M.P.H.
- Hui-Lee Wong, Ph.D., M.S.

ODE:

- Kanchana Iyer, M.S.

Introduction
Device Description
Regulatory History

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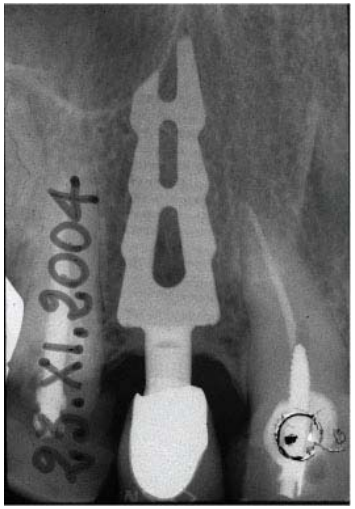
Scope of Panel Meeting

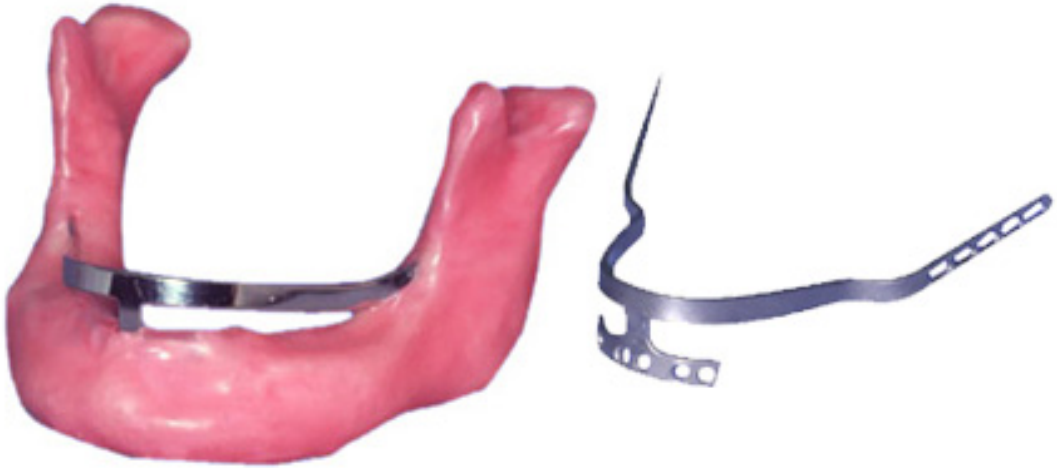
21 CFR 872.3640(b)(2): Class III (premarket approval), if it is a blade-form endosseous dental implant made of a material such as titanium or titanium alloy, that is intended to be surgically placed in the bone of the upper or lower jaw arches to provide support for prosthetic devices, such as artificial teeth, in order to restore a patient's chewing function.

Device Description

Blade-form implant

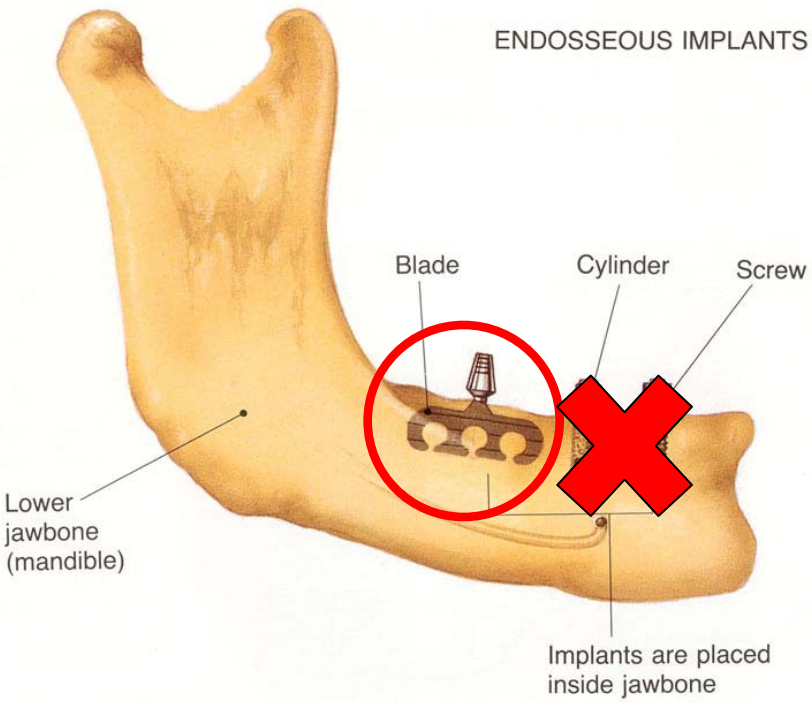


Ramus Frame Blade-form implant



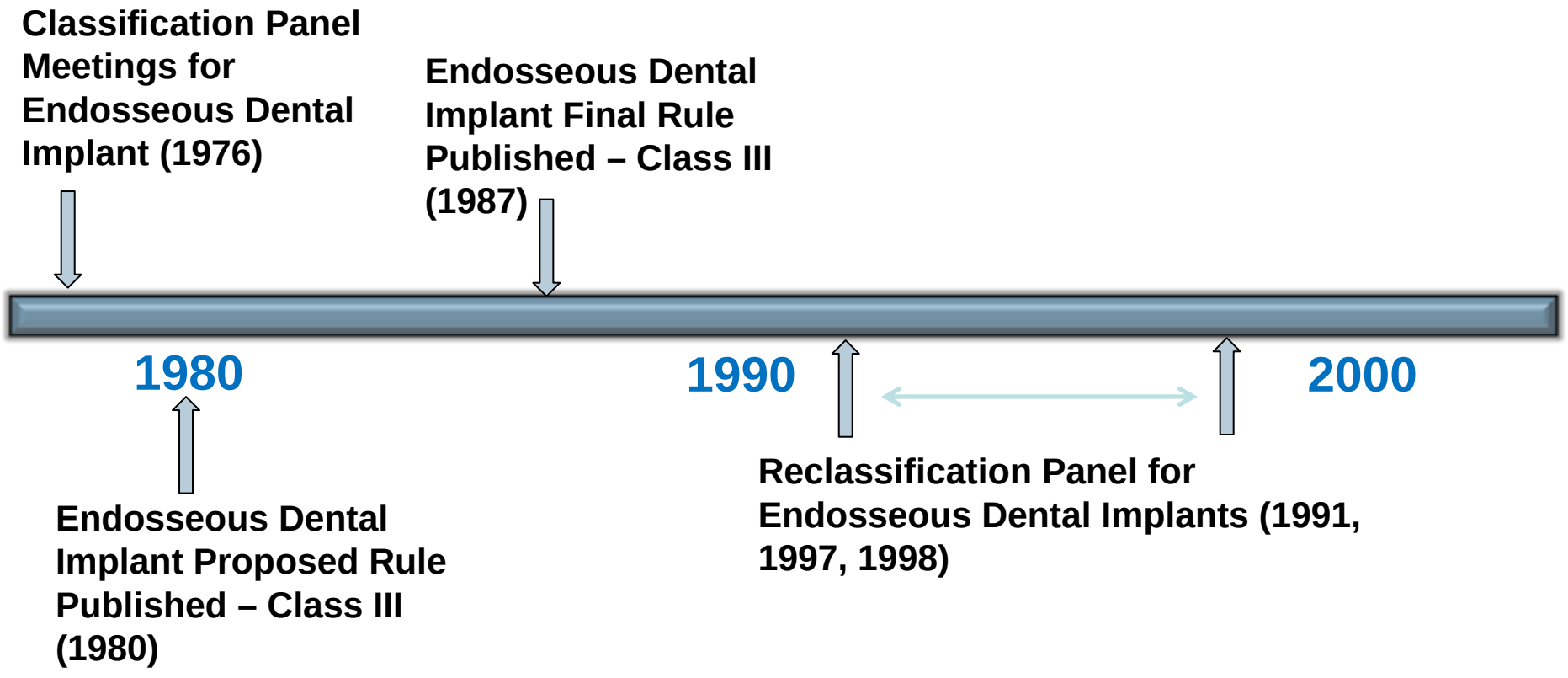
Device Description

Root-form implants



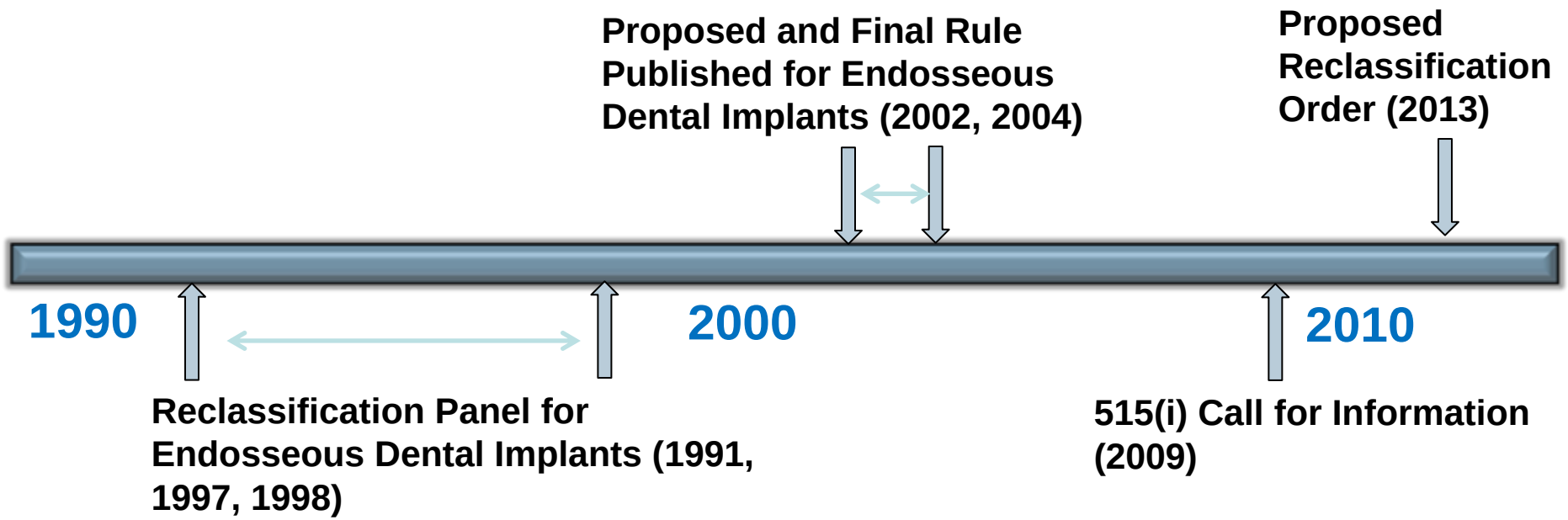
Regulatory History

Endosseous Dental Implants



Regulatory History

Endosseous Dental Implants



Responses to the Proposed Reclassification Order

- FDA received responses from 1 clinician and 1 manufacturer of Endosseous Dental Implant (Blade-form).
- Responses unanimously recommended reclassification into Class II.

Clinical Background

Edentulism

- Lack of teeth – Partial or Full
  - Periodontal Disease
  - Trauma
  - Primary or Secondary dental caries
  - Congenitally missing teeth

Restorative Measures

- Fixed or Removable Partial or Full Denture
- Fixed Bridge
- Endosseous Dental Implant

Systematic Literature Review of Endosseous dental implant (Blade-form)

Carolina Alvarez-Garriga, MD, DrPH

Epidemiologist
Division of Epidemiology
Office of Surveillance and Biometrics

July 18, 2013

Outline

- Research question
- Methods
- Results on long term safety and effectiveness
  - Success rate
  - Survivability
- Assessment
- Summary

Research Question

What is the evidence for long-term safety and effectiveness of Endosseous dental implant devices (blade-form) based on success rate and survivability?

Methods

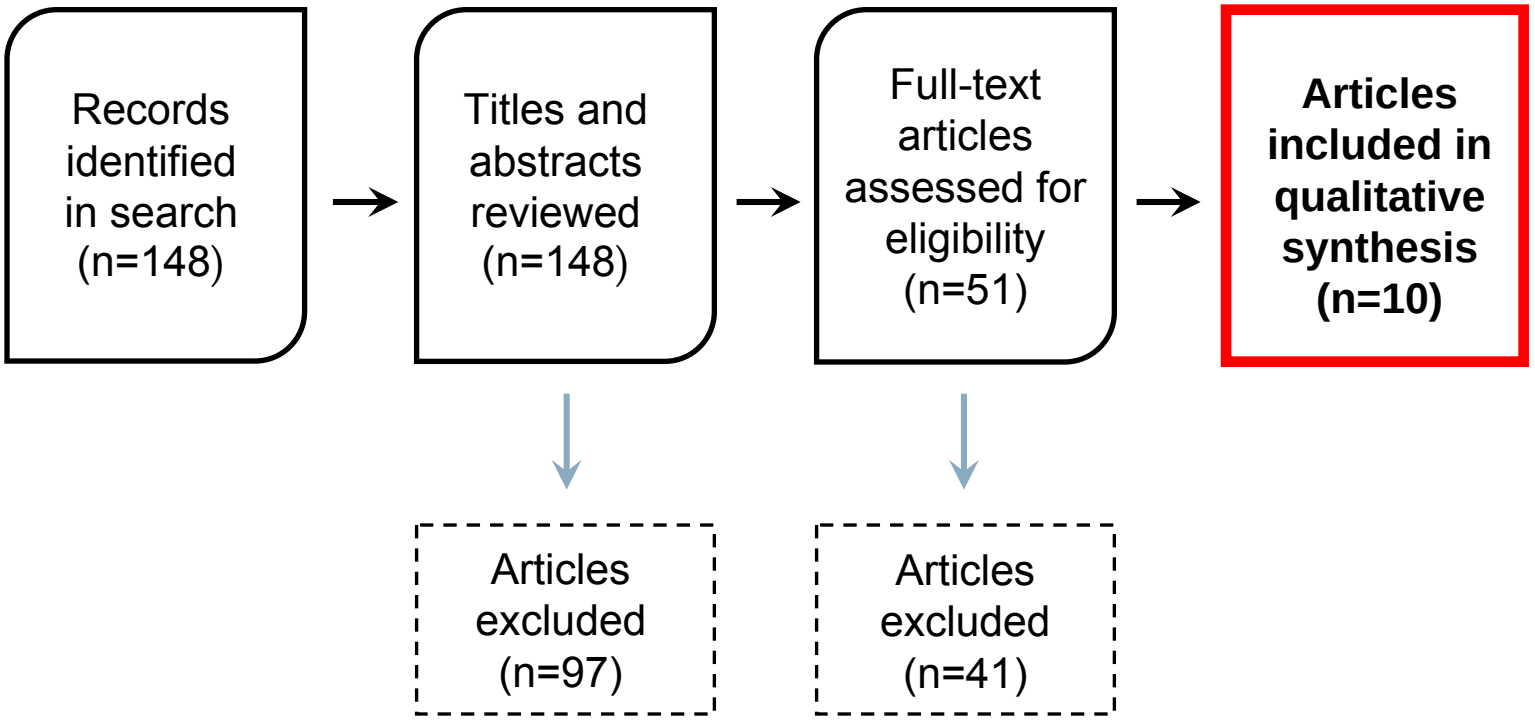
- Searched Pubmed, Embase, and Web of Science (WOS) using all of the following terms:
  - “dental blade implant” or “dental blade implants” or
  - “blade implant” or “'blade implants”
  - “dental blade endosseous” or “dental endosseous”
  - “surface treatment”
  - “tooth implantation/syn”

- Timeframe: From January 1, 1987 to April 18, 2013 to update previous searches that had no time limits.

Inclusion Criteria

- Human studies
- English language
- Study designs
  - Randomized Controlled Trial (RCT)
  - Observational Study
  - Systematic Literature Review
  - Meta-Analysis
  - Case Series with n ≥ 10

Article Retrieval and Selection



Results: Overall

- Ten papers identified
  - RCT (n=1)
  - Observational studies (n=9)
- Published between 1987 and 2013
- Sample size ranged from 18 to 131 patients
- Age ranged from 14 to 86 years (mean = 51)
- Follow-up period ranged from 3 to 20 years
- 6 conducted in US, 2 in Japan, 1 in Germany, 1 in Slovak and Czech Republic.

Results: 5 year rates

- Survivability ranged from 86 to 100%
- Success rate ranged from 90 to 100%
  - Noak (1999): absence of persistent subjective complaints, recurrent peri-implant infection with suppuration, mobility, and continuous radiolucency around the implant
  - Kapur (1987): absence of treatment and implant failure
  - Roberts (1996): functional, stable without significant settling, and did not exhibit any major inflammatory response
  - Seven articles: undefined measure of success

Results: Adverse Events Reported in Publications

Author, year	Range of follow-up	Bone loss or Bone deterioration	Swelling/pain	Infection/ Periodontal Disease	Mobility	Implant fracture
Takeshita F, 1996	1 – 8 years	*100%* (7/7 failures)*	*43%* (3/7 failures)*	*43%* (3/7 failures)*	*43%* (3/7 failures)*	*14%* (1/7 failures)*
Telsey B, 1991	1 - 15 years	9.1% (6/66)	9.1% (6/66)	9.1% (6/66)		1.5% (1/66)
Takeshita F, 1996	1 - 6 years		1% (1/78)		1% (1/78)	2% (2/78)
Roberts RA, 1996	1 - 26 years	1.7% (4/235)		0.4% (1/235)		1.3% (3/235)
Kapur KK, 1989	1 - 5 years	3.9% (6/155)	3.9% (6/155)		1.3% (2/155)	
Smithloff, 1987	1 - 15 years			50%** (13/26)	7.7% (2/26)	3.8% (1/26)
Acevedo Al, 1987	1 - 5 years	18% (16/91)				
Hahn JA, 1990	1 – 3 years					
Noack N, 1999	1 – 16 years					
Strecha J, 2010	1 - 5 years					

Number of adverse events/number of implants placed
*Proportion of adverse events among seven implants that were removed, **Moderate periodontal disease

Results: RCT

Kapur KK, et al. (1987)

- The study compared two devices:
  - Fixed partial dentures supported by blade-vent implants fixed partial denture (FPD), n=114
  - Removable partial dentures (RPD), n=119
- Results:
  - 5-year success rate: FPD 84.2% vs. RPD 74%
  - Treatment failures occurred in 19 FPD patients and 30 RPD patients during 5-year follow-up.
  - Bone deterioration: 29.6% None

    41.3% Slight/Moderate

    29.1% Marked/Severe

Assessment:

Observational Studies

- Retrospective Studies (9)
  - 6 had small sample size (n<50)
  - Single dental offices
  - Overall success proportion at five years is above 90%

Assessment:

Observational Studies

Limitations:

- The power and generalizability of the results to overall population are limited
- The success/failure rates did not include any information regarding the reasons for implant failure
- Adverse events were not systematically reviewed
- No results were stratified by gender in any study

Assessment: RCT

Kapur KK, et al. (1987)

- Limitations:
  - Only recruited male veteran patients
  - The study focused mainly on effectiveness and not safety

- Advantages:
  - Randomization
  - Confounding factors are equally distributed

Summary

- Success rate from 90 to 100% at five years of follow-up was found except for one study reporting 84.2% in males only (RCT).
- A long-term 100% device survivability was widely reported.
- Bone loss and deterioration was the most commonly reported adverse event.
- Available evidence suggests that the device is effective and has a satisfactory long-term safety profile.

Adverse Event Analysis: Manufacturer and User Facility Device Experience (MAUDE Search)

MAUDE Search- Adverse Events

- MDR reporting: the mechanism for the FDA to receive significant medical device adverse events from manufacturers, importers and user facilities.
- 1993 to May 30, 2013
- 0 MDRs

MAUDE Search: Limitations

- Product code may not correspond to the device that was used for treatment.
- Lack of report does not signify a specific adverse event type did not occur.

Risk to Health & Special Controls

Risks to Health

- Local tissue or existing dentition degeneration due to:
  - Excessive mobility
  - Loss of integration
  - Incompatibility of the device components
  - Structural failure of the device
- Pain
- Infection
- Adverse tissue reaction
- Bone or nerve damage
  - Sinus perforation
  - Alveolar plate perforation
  - Transient or chronic pain/facial paresis
- Migration or thermal injury
  - Incompatibility with MRI

The panel will be asked to address the completeness of the risks to health for endosseous dental implants (blade-from).

Proposed Special Controls

- Design characteristics
- Mechanical testing
- Corrosion testing
- Magnetic resonance (MR) environment compatibility
- Biocompatibility
- Sterility
- Labeling
  - Prescription device labeling
  - Patient labeling
- Documented clinical experience

Design Characteristics

- Design characteristics must be consistent with the intended use:
  - Geometry
  - Material composition

Mechanical Testing

- Non-clinical performance testing must demonstrate the mechanical function and durability of the blade-form implant under simulated physiological conditions including compressive and shear loads. Mechanical testing should include:
  - Static Testing of the worst case scenario
  - Fatigue Testing of the worst case scenario

Additional Bench Testing

- Corrosion testing
  - Corrosion potential of each metal or alloy
  - Couple potential for assembled dissimilar metal systems
  - Corrosion rate for assembled dissimilar metal systems
- MR environment compatibility
  - MR conditions without device heating or migration.

Biocompatibility

- Material characterization, including conformance to material standards, must demonstrate biocompatibility of the device materials and any potential byproducts (e.g., wear debris, leachates, etc).
  - Identification of relevant patient contact type and duration (e.g., ISO 10993: *Biological Evaluation of Medical Devices)*
  - Identification of relevant Material Standards (e.g., ASTM F136, ASTM F67)

Sterility

- Sterilization validation must demonstrate the sterility of, or the ability to sterilize, the device components.
  - Device components and instruments
  - Sterility Assurance Level (SAL) of 10^{-6}

Labeling

- Must bear all information required for the safe and effective use of the device:
  - Indications for use
  - Clear description of device technological features including identification of device materials
  - Device specific warnings, precautions, and contraindications
  - Identification of MR compatibility status
  - Sterilization instructions
  - Detailed instructions of each surgical and restorative step accompanied by magnified illustrations

Labeling

- Patient labeling should describe:
  - Blade-form implant device and surgery
  - Care for the implant
  - Possible adverse events
  - Reporting of complications

Clinical Experience

- A discussion of documented clinical experience of the device or similar design device based on published literature or clinical use.
- Demonstrates safe and effective use and captures any adverse events observed during clinical use.

Mitigation of Risks to Health

Risks to Health

Identified Risk	*Recommended Mitigation Measures*							
	Design characteristics	*Mechanical Testing*	*Corrosion testing*	*MR environment compatibility*	*Bio-compatibility*	*Sterility*	*Labeling*	*Clinical Experience*
Local tissue or existing dentition degeneration	Yes	Yes	Yes		Yes		Yes	Yes
Pain							Yes	Yes
Bone or nerve damage	Yes						Yes	Yes
Infection						Yes	Yes	
Adverse tissue reaction	Yes				Yes		Yes	
Migration or thermal injury				Yes			Yes	

Summary: Proposed Special Controls

- **Design characteristics** - *The design characteristics of the device must ensure that the geometry and material composition are consistent with the intended use.*
- **Mechanical testing** - Mechanical performance (fatigue) testing under simulated physiological conditions to demonstrate maximum load (endurance limit) when the device is subjected to compressive and shear loads.
- **Corrosion testing** - *Corrosion testing under simulated physiological conditions to demonstrate corrosion potential of each metal or alloy, couple potential for an assembled dissimilar metal implant system, and corrosion rate for an assembled dissimilar metal implant system.*
- **MR environment compatibility** - *Performance testing to evaluate the compatibility of the device in a magnetic resonance (MR) environment.*

Summary: Proposed Special Controls

- **Biocompatibility** - *The device must be demonstrated to be biocompatible.*
- **Sterility** - *Sterility testing must demonstrate the sterility of the device.*
- **Labeling** - *Labeling must include a clear description of the technological features, how the device should be used in patients, detailed surgical protocol and restoration procedures, and relevant precautions warnings based on the clinical use of the device.*
- **Patient labeling** - *Patient labeling must contain a description of how the device works, how the device is placed, how the patient needs to care for the implant, possible adverse events and how to report any complications.*
- **Documented clinical experience** - Document clinical experience must demonstrate safe and effective use and capture any adverse events observed during clinical use.

The panel will be asked to comment on the adequacy of the proposed special controls to mitigate the risks to health for endosseous dental implants (blade-form).

FDA Conclusions: Safety and Effectiveness

FDA Conclusions

- The available scientific evidence supports a reasonable assurance of safety and effectiveness for the use of endosseous dental implants (blade-form) for restoration of chewing function.
- The proposed special controls can be established.
- There is not an unreasonable risk of illness or injury for the endosseous dental implants (blade-form) when general and special controls are applied

Thank You

Questions?